

Abstract for the 16th IAEA International Conference on  
Plasma Physics and Controlled Nuclear Fusion Research  
October 7-11, 1996, Montreal, Canada

**Hydrodynamic instability experiments on the Nova laser,\*** B.A. Remington, S.G. Glendinning, D.H. Kalantar, K.S. Budil, O.L. Landen, B.A. Hammel, M.M. Marinak, S.V. Weber, C.J. Keane, S.W. Haan, A. Rubenchik, R.J. Wallace, *LLNL, Livermore, CA, USA*, M.H. Key, *Rutherford-Appleton Laboratory UK*, J.P. Knauer, *LLE, Univ. Rochester, USA*, W.W. Hsing, *LANL, Los Alamos, NM, USA*, D. Galmiche, M.A. Blain, *CEA Centre d'Etudes de Limeil-Valenton, France*, J. Kane and D. Arnett, *Univ. of Arizona, USA*, and M. Berning, *Düsseldorf Univ., Düsseldorf, Germany*. Hydrodynamic instabilities in compressible plasmas play a critical role in the fields of inertial confinement fusion, astrophysics, and high energy-density physics. We are investigating the Rayleigh-Taylor (RT), Richtmyer-Meshkov (RM), and Kelvin-Helmholtz (KH) instabilities at high compression at the Nova laser in a series of experiments, both in planar and in spherical geometry.<sup>1</sup> In the indirect drive approach, a thermal x-ray drive is generated by focusing eight of the ten Nova laser beams into a Au cylindrical radiation cavity (hohlraum). The remaining two beams are typically used for generating x-ray backlighters for foil diagnosis. Issues in the instability evolution that we are examining are shock propagation and foil compression,<sup>2</sup> RT growth of 2D versus 3D single-mode perturbations,<sup>3</sup> drive pulse shape,<sup>4</sup> perturbation location at the ablation front versus at an embedded interface,<sup>5</sup> and multimode perturbation growth and nonlinear saturation.<sup>6</sup> The effects of convergence on RT growth are being investigated both with hemispherical implosions of packages mounted on the hohlraum wall and with spherical implosions of capsules at the center of the hohlraum.<sup>7</sup> Single-mode perturbations are pre-imposed at the ablation front of these capsules as a seed for the RT growth. We have started a new series of experiments on Nova to investigate specific issues regarding hydrodynamic instabilities in astrophysics, in particular, the deep nonlinear mixing due to all three instabilities (RT, RM, and KH) that occurs in Type II supernovae.<sup>8,9</sup> In our direct drive experiments, we are investigating the effect of laser imprinting and subsequent RT growth on planar foils, both at  $\lambda_{\text{Laser}}=1/3 \mu\text{m}$  and  $1/2 \mu\text{m}$ .<sup>1,10,11</sup> One new series of experiments uses CH<sub>2</sub> foils with a standard thermal x-ray backlighter to compare imprint efficiency of  $1/3 \mu\text{m}$  versus  $1/2 \mu\text{m}$  laser light. Another experimental series uses thin Si foils imprinted with low intensity  $1/3 \mu\text{m}$  laser light and probed at very high spatial resolution with an yttrium x-ray laser backlighter.<sup>11</sup> An overview will be given describing recent progress in each of these areas. \*Work performed under the auspices of the U.S. Department of Energy by the Lawrence Livermore National Laboratory under contract number W-7405-ENG-48.

- <sup>1</sup>J.D. Kilkenny *et al.*, Phys. Plasmas **1**, 1379 (1994).
- <sup>2</sup>B.A. Hammel *et al.*, Phys. Fluids B **5**, 2259 (1993); Phys. Plasmas **1**, 1662 (1994).
- <sup>3</sup>M.M. Marinak *et al.*, Phys. Rev. Lett. **75**, 3677 (1995); Phys. of Plasmas, in press (July, 1996).
- <sup>4</sup>S.V. Weber *et al.*, Phys. Plasmas **1**, 3652 (1994).
- <sup>5</sup>K.S. Budil *et al.*, submitted, Phys. Rev. Lett. (1996); Bull. Am. Phys. Soc. **40**, 1749 (1995).
- <sup>6</sup>B.A. Remington *et al.*, Phys. Rev. Lett. **73**, 545 (1994); Phys. Plasmas **2**, 241 (1995).
- <sup>7</sup>D.H. Kalantar *et al.*, Bull. Am. Phys. Soc. **40**, 1856 (1995).
- <sup>8</sup>J. Kane *et al.*, Bull. Am. Phys. Soc. **40**, 1841 (1995); M. Wood-Vasey *et al.*, Bull. Am. Phys. Soc. **40**, 1841 (1995).
- <sup>9</sup>E. Müller, B. Fryxell, and D. Arnett, Astron. Astrophys. **251**, 505 (1991).
- <sup>10</sup>S.G. Glendinning *et al.*, Phys. Rev. Lett. **69**, 1201 (1992); submitted, Phys. Rev. Lett. (1996).
- <sup>11</sup>D.H. Kalantar *et al.*, in press, Phys. Rev. Lett. (April, 1996); Bull. Am. Phys. Soc. **40**, 1749 (1995).